

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>713-258 PCT</b>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <b>FOR FURTHER ACTION</b> </div> <div style="font-size: small;">             see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.           </div> </div>	
International application No. <b>PCT/US 99/ 30521</b>	International filing date (day/month/year) <div style="text-align: center;"><b>22/12/1999</b></div>	(Earliest) Priority Date (day/month/year) <div style="text-align: center;"><b>22/12/1998</b></div>
Applicant  <b>ILLINOIS TOOL WORKS, INC. et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

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☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (see Box II).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1  
☐ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

P US 99/30521

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01T23/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01T H05F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 153 811 A (RODRIGO RICHARD D ET AL) 6 October 1992 (1992-10-06) cited in the application the whole document ---	1,6
A	US 5 008 594 A (SWANSON RALPH W ET AL) 16 April 1991 (1991-04-16) cited in the application ---	
A	EP 0 212 931 A (SIDHA TECHNOLOGY LTD) 4 March 1987 (1987-03-04) -----	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

Date of the actual completion of the international search

20 April 2000

Date of mailing of the international search report

02/05/2000

Name and mailing address of the ISA

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Bijn, E

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

P S 99/30521

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5153811	A	06-10-1992	NONE	
US 5008594	A	16-04-1991	NONE	
EP 0212931	A	04-03-1987	GB 2179503 A	04-03-1987

# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

**PCT**

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

**Date of mailing (day/month/year)**

28 August 2000 (28.08.00)

**International application No.**

PCT/US99/30521

**Applicant's or agent's file reference**

713-258 PCT

**International filing date (day/month/year)**

22 December 1999 (22.12.99)

**Priority date (day/month/year)**

22 December 1998 (22.12.98)

**Applicant**

RODRIGO, Richard, D. et al

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

18 July 2000 (18.07.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was



was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
34, chemin des Colombettes  
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Facsimile No.: (41-22) 740.14.35

Authorized officer

Manu Berrod

Telephone No.: (41-22) 338.83.38

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

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NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Date of mailing  
(day/month/year) 15.03.2001

Applicant's or agent's file reference  
713-258 PCT

**IMPORTANT NOTIFICATION**

International application No.  
PCT/US99/30521

International filing date (day/month/year)  
22/12/1999

Priority date (day/month/year)  
22/12/1998

Applicant  
ILLINOIS TOOL WORKS, INC. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

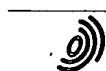
**4. REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> :

H01T 23/00

A1

(11) International Publication Number:

WO 00/38288

(43) International Publication Date:

29 June 2000 (29.06.00)

(21) International Application Number: PCT/US99/30521

(22) International Filing Date: 22 December 1999 (22.12.99)

(30) Priority Data:

60/113,211

22 December 1998 (22.12.98)

US

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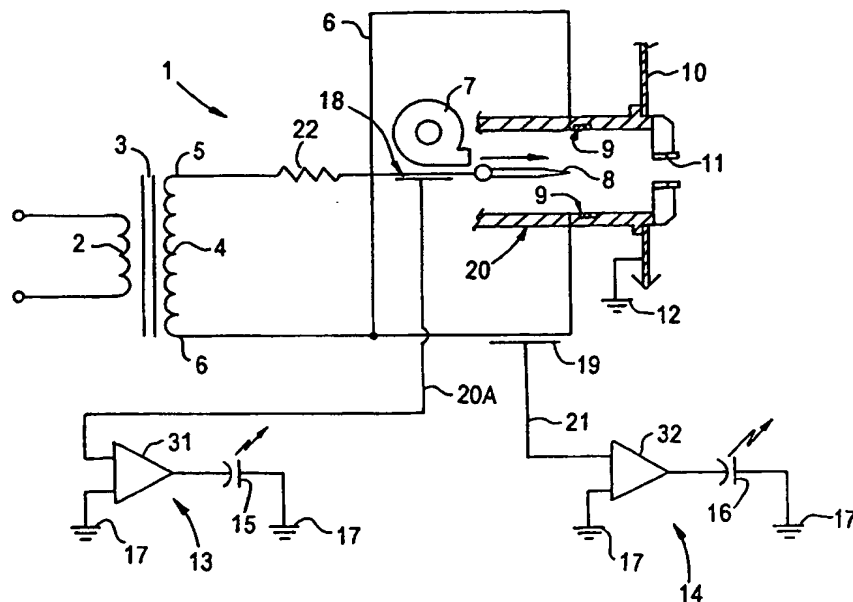
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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published***With international search report.**Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: SELF-BALANCING IONIZER MONITOR

**(57) Abstract**

A monitor apparatus and corresponding method of monitoring high voltage alternating current in the emitter and reference circuits of ionizers. The monitor is capacitively coupled to the emitter and reference circuits to detect faults without affecting the ionizer operation. Faults are displayed on a light emitting diode display. In an alternative embodiment, faults may be indicated by output signals. The output signals are used to automatically adjust the ionizer operation.

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SELF-BALANCING IONIZER MONITORRelated Applications

The present application claims priority of U.S. Provisional Application Serial No. 60/113,211, filed December 22, 1998, entitled "Self-Balancing Ionizer Monitor", the disclosure of which is incorporated by reference herein in its entirety.

Technical Field

This invention pertains to ion balance monitor methods and apparatus. The ion balance monitor monitors the ion output and ion balance of the ionizer and indicates the status of the ionizer to an operator. Such ion balance expedients are useful in controlling the desired balance or desired degree and type of imbalance of positive and negative ions in gas environments. More particularly, the invention is useful in connection with air blowers and charged electrode ion emitters as are used in controlling the ionization polarity in rooms or other spaces. Such control is useful in many fields, as in controlling the ionization of the air in clean rooms in which microchips are manufactured, as a single example.

Background Art

There is a need to monitor ionizers for (1) ion output and (2) ion balance. This is fairly easy to achieve with DC ionizers by monitoring the DC current due to ionization in the return of the power supply. It is more difficult to do with AC ionizers, especially of the self-balancing type, due to lack of return on power supply and the fact that AC ionization current is very



small as compared with other currents in the AC high voltage circuit.

Some prior attempts have been made to monitor the ion balance in an ionizer. Known attempts include U.S. Patent 4,477,263. This patent discloses a DC grid with a sensor system to monitor the balance. The balance is sensed in the room and is manually adjusted to a null meter reading on the controls.

U.S. Patent 4,630,167 discloses a plate sensor in the work area and an infrared link to control ion balance in a pulsed DC system having spaced apart emitters.

U.S. Patent 4,809,127 discloses a pulsed DC system of air ionizers. The ion current is sampled through a resistor and is used to regionally adjust the emitter output.

U.S. Patent 4,901,194 discloses sequenced positive and negative pulses. The ion current with an integrating feature maintains average ion conditions in the room and controls the pulse generators.

U.S. Patent 4,951,172 discloses a guarded sensor/control system. The sensor is a guarded probe placed in the work area.

There are of course many patents relating to ion balance. These include the following U.S. patents: 2,264,495; 2,879,395; 3,714,531; 4,423,462; 4,092,543; 3,936,698; 4,740,862; 4,757,422; 4,872,083; 5,008,594; 5,055,963; 5,153,811; 3,711,743; 4,435,195; 5,047,892; 5,057,966; 4,476,514; 4,528,612; 4,974,115; 4,542,434; 4,878,149; 4,642,728; 4,757,421; and 4,785,248.

### Summary of the Invention

The monitor of the present invention senses the high voltage alternating current in the emitter and senses the reference circuits of the ionizer. The sensing circuits are capacitively coupled to the emitter and reference circuits. Faults may be detected and displayed on trip

alarm light emitting diode displays or by other output signals. The output signals may be used to automatically adjust the system by known means. Capacitive coupling used in this way is believed to be novel. The invention permits the monitoring function to be accomplished without interfering with the operation of the self-balancing circuit.

It is accordingly an object of the present invention to monitor ionizers for ion output and ion balance.

Another object is to monitor ionizers for ion output and balance in AC ionizers, particularly of the self-balancing type.

Still another object is to monitor high voltage and ion output and ion balance in self-balancing ionizers by sensing AC high voltage in both high voltage emitter and reference circuits.

There are certain typical, though rare, faults that adversely affect the ion balance. Faults that produce no ion output, such as a dead transformer, the emitter shorted to ground, or the emitter shorted to reference, etc., result in zero or very low AC voltage to ground in the emitter circuit. Faults that result in ion imbalance, such as the reference shorted to ground, result in a zero or very low AC voltage to ground in the reference circuit. In the present invention, the emitter and reference circuits are capacitively coupled with the sensing circuits whereby normal and abnormal operation are sensed without interfering with the function of the self-balancing circuit. This sensing is accomplished by performing a peak detection of the AC signal present on both the emitter and reference circuits, separately. These peak detected signals are then passed on to circuits with variable thresholds. The comparator circuits are used to trip alarm LEDs when the peak detector levels fall below the thresholds. Optional

output signals of any desired other kind can be derived from these processed signals by known conventional means.

Still other objects and advantages of the present invention will become readily apparent to those skilled in this art from the following detailed description, wherein only the preferred embodiments of the invention are shown and described, simply by way of illustration of the best mode contemplated of carrying out the invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the invention. Accordingly, the drawing and description are to be regarded as illustrative in nature, and not as restrictive.

#### Brief Description of Drawings

Fig. 1 is a schematic view of the overall ionizer apparatus showing the connections and relationships of the ion balance and ion output circuits.

Fig. 2 is a schematic view of the details of the ion balance and ion output monitor circuits.

#### Best Mode for Carrying out the Invention

The monitor according to the present invention operates by sensing the AC high voltage in the emitter and reference circuits of the ionizing assembly. Under normal conditions, the emitter circuit has approximately 3 KVAC (kilovolt alternating current) with respect to ground and the reference circuit has approximately 2 KVAC with respect to ground.

Existing monitoring circuits typically depend on measuring current due to ionization itself. This direct measurement typically results in connections between the ionizing circuit and ground through which net DC currents can flow. These connections to ground with net DC currents are incompatible with the operation of self-

balancing ionizers. The monitoring circuit of the present invention uses capacitors (either discrete components or via capacitive coupling) to block DC currents to ground.

5       The use of capacitive coupling to monitor a self-balancing ionizer's performance is a new expedient. Intrusive (directly connected) monitoring systems were incompatible with and would interfere with the operation of self-balancing ionizers. The fact that the self-balancing ionizer uses AC enables the use of capacitive  
10       coupling to monitor the ionizer performance.

      This circuit enables the monitoring of two aspects (ion output and ion balance) in self-balancing ionizers. The monitor does not affect the operation of the self-balancing circuit. The monitoring is performed in a cost  
15       effective manner. This circuit can provide ionizer operation status output for remote monitoring.

      It has been found possible in the present invention to monitor high voltage (HV) ion output and ion balance on  
20       self-balancing ionizers by sensing the AC HV in both the HV (emitter) and reference circuits. Under normal conditions approximately 3 KVAC with respect to ground manifests itself in the HV (emitter) circuit and approximately 2 KVAC with respect to ground manifests  
25       itself in the reference circuit.

      Typical faults for no ionization (dead transformer, or points shorted to ground) result in zero or very low AC voltage to ground in the HV (emitter) circuit. Typical faults for ion imbalance (reference shorted to  
30       ground) result in zero or very low AC voltage to ground in the reference circuit.

      The present invention is able to monitor for these conditions as best initially shown in Fig. 1. This simple circuit provides monitoring of self-balancing  
35       ionizers without affecting the self-balancing function. An example of such a self-balancing ionizing circuit for

a static eliminator to which the present invention may be applied is shown in U.S. Patent 5,153,811. The high voltage transformer is generally designated 1. It comprises a primary winding 2, a core 3, and a secondary winding 4. The high voltage lead 5 connects one end to the secondary to the HV electrode emitter 8. The reference lead 6 connects to the other end of the secondary to the reference electrode 9.

A blower 7 propels a stream of air in the direction indicated by the arrow over the emitter 8, the reference electrode 9 and through the orifice 11 into the region to be treated. The electrodes are contained within an ionizing chamber 20. The orifice 20 is mounted on and the whole ionizing device is encased in case 10. The structure described above in connection with Figure 1 is conventional.

A high voltage capacitive pickup 18 is provided at the HV lead 5. An ion output sensing lead 20A connects capacitive pickup 18 to an ion output sensor generally designated 13. The ion output sensor 13 comprises a comparator 31 shown in simplified form and a LED alarm display 15.

A reference voltage capacitive pickup 19 is provided at the reference lead 6. An ion balance lead 21 connects capacitive pickup 19 to an ion balance sensor generally designated 14. The ion balance sensor 14 comprises a comparator 32 shown in simplified form and a LED alarm display 16.

The case 10 is provided with ground 12 and the comparators 31 and 32 are each provided with grounds 17, as shown in Figure 1. Each of the comparators may be a standard part LM339, though it is understood that the specification herein of a particular industry part number or description does not limit the invention, and functional equivalents for any of the specified components may be used as within the skill of the art.

The output sensors 13 and 14 are shown in more schematic detail in Figure 2. The upper portion of Figure 2 shows the ion output sensor 13 portion and the lower portion of Figure 2 shows the ion balance 14 portion. Like reference numerals and part designations in the upper and lower portions refer to like parts. As shown in Figure 1, the HV lead 5 is capacitively coupled 18 to lead 20A and the reference lead 6 is capacitively coupled 19 to lead 21. The signals from the capacitor couplings 18 and 19 are each amplified through a transistor 34 and 35 respectively, standard part MPS2222A, the outputs of which continue through diode 24, which is standard part 1N4002. Thereafter, each of the leads 36 and 37 is grounded through a 1 microfarad capacitor 25 and also each is grounded through a 1M Ohm resistor 26.

Continuing the path of each lead 36 and 37, each is connected to a + (positive) input of a comparator 31 and 32, respectively. A +5 volt source is connected through a 10K Ohm resistor and to ground through a variable 10K Ohm resistor 27 and thence to the - (negative) input of a comparator. The variable resistors are set to provide the desired thresholds. Thereafter, the output of each comparator 31 and 32 is grounded through a 1K Ohm resistor and then continues respectively to an ion output display alarm 15 or a balance alarm display 16. The back end of display 16 is coupled to the front end of display 15 through 1.2K Ohm resistor 29. The back end of display 15 goes to a +5 volt source through a 1.2K Ohm resistor 30. The structure is best understood by reference to Figure 2.

If the AC signal disappears from the HV leads, the ion output alarm occurs. If the AC signal disappears from the referencing leads, the ion balance alarm occurs. If the AC signal disappears from both leads, only the ion output alarm occurs.

It will be readily seen by one of ordinary skill in the art that the present invention fulfills all of the objects set forth above. After reading the foregoing specification, one of ordinary skill will be able to effect various changes, substitutions of equivalents and various other aspects of the invention as broadly disclosed herein. It is therefore intended that the protection granted hereon be limited only by the definition contained in the appended claims and equivalents thereof.

What is claimed is:

1. An ionizer monitor adapted to detect faults in high voltage circuits of an ionizer, said monitor comprising a sensing circuit capacitively coupled to said high voltage circuits for detecting faults.
2. An ionizer monitor as in claim 1, wherein said high voltage circuits are a reference circuit or an emitter circuit.
3. An ionizer monitor as in claim 1, wherein said ionizer is a self-balancing ionizer.
4. An ionizer monitor as in claim 1, further comprising an alarm display coupled to said sensing circuit for indicating fault detection.
5. An ionizer monitor as in claim 1, further comprising a control circuit coupled to said sensing circuit for controlling said ionizer responsive to fault detection.
6. A method of detecting faults in high voltage circuits of an ionizer without affecting operation of



10

said high voltage circuits, said method comprising the steps of:

- 5           sensing the voltage of said high voltage circuits by capacitively coupling a sensing circuit with said high voltage circuit; and

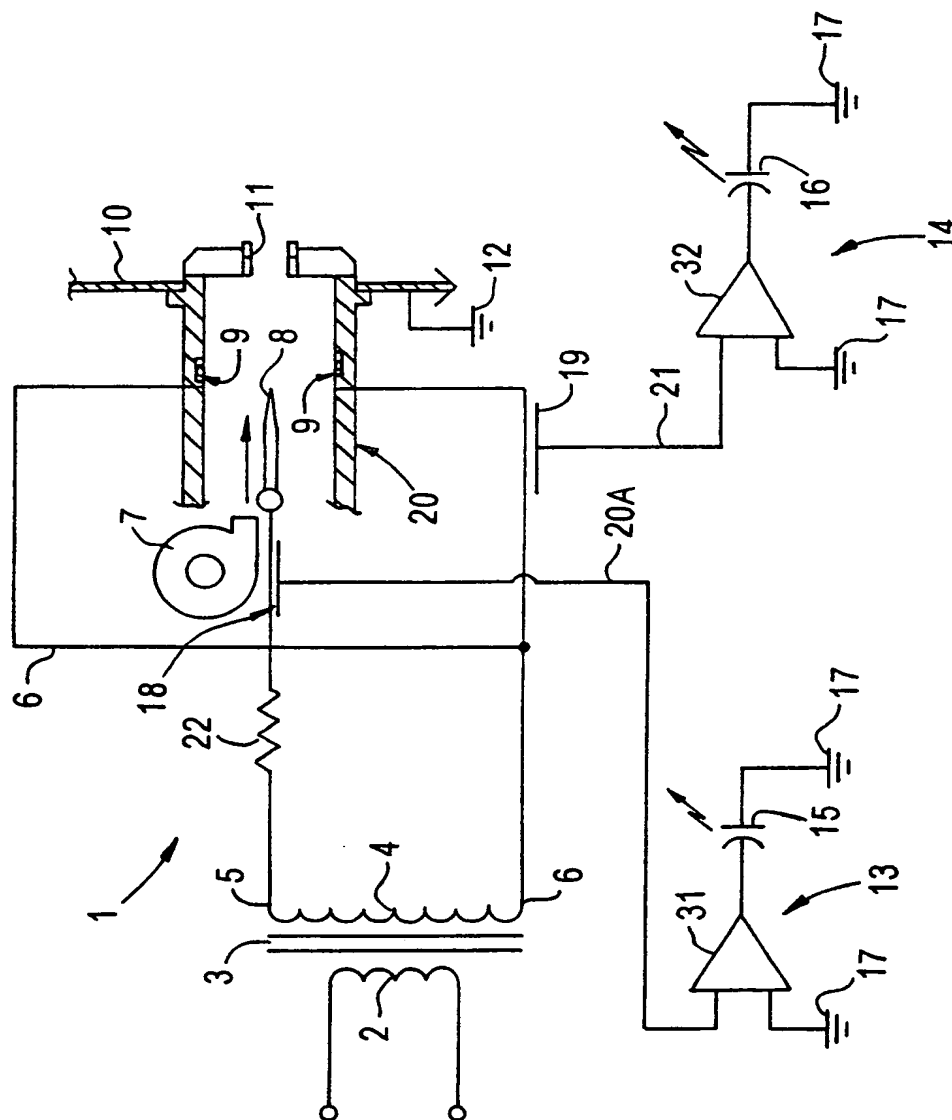
          comparing the sensed voltage with a threshold voltage.

7. A method as in claim 6, further comprising the step of displaying an alarm if said sensed voltage is less than or equal to said threshold voltage.

8. A method as in claim 6, wherein said high voltage circuits are a reference circuit or an emitter circuit.

9. A method as in claim 6, wherein said ionizer is a self-balancing ionizer.

10. A method as in claim 6, further comprising the step of controlling said ionizer in response to said sensing step sensing a voltage less than or equal to said threshold voltage.



**FIG. 1**

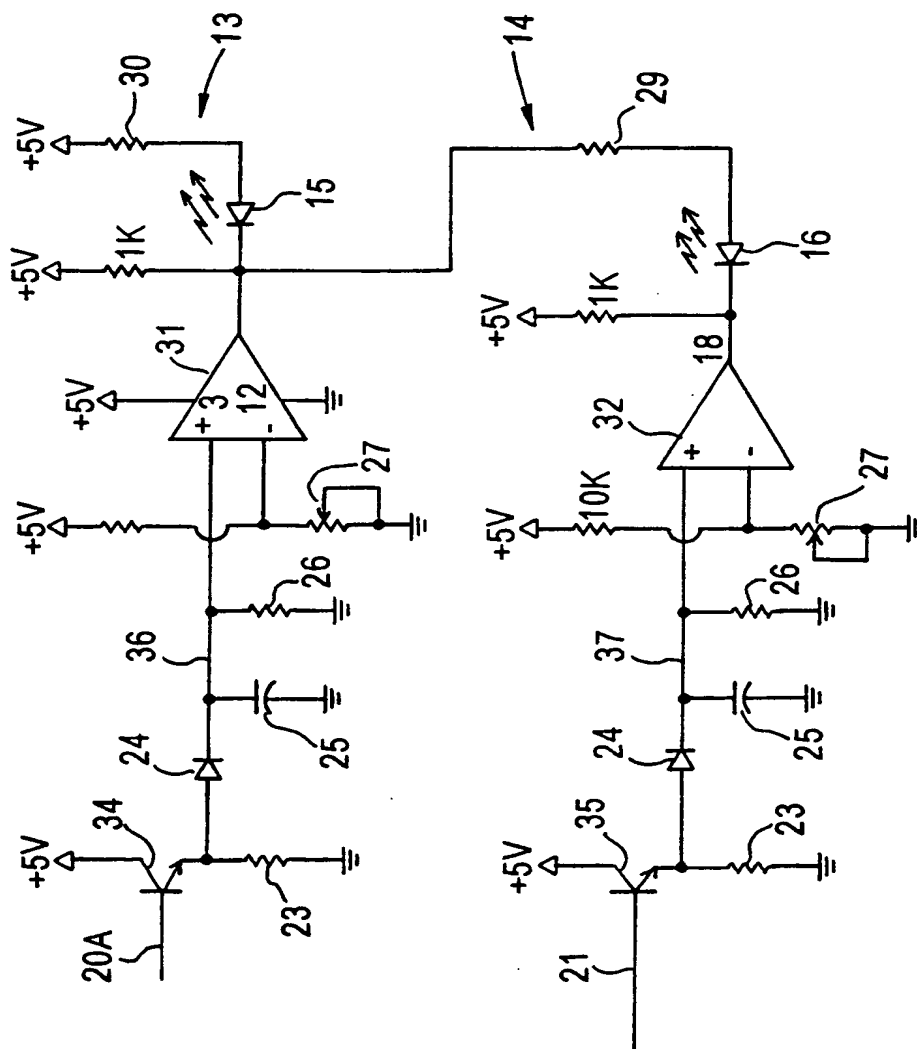


FIG. 2

## INTERNATIONAL SEARCH REPORT

Int. Application No

PCT/US 99/30521

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H01T23/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01T H05F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 153 811 A (RODRIGO RICHARD D ET AL) 6 October 1992 (1992-10-06) cited in the application the whole document	1,6
A	US 5 008 594 A (SWANSON RALPH W ET AL) 16 April 1991 (1991-04-16) cited in the application	
A	EP 0 212 931 A (SIDHA TECHNOLOGY LTD) 4 March 1987 (1987-03-04)	

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

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Date of the actual completion of the international search

20 April 2000

Date of mailing of the international search report

02/05/2000

Name and mailing address of the ISA

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. Application No

PCT/US 99/30521

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5153811	A	06-10-1992	NONE	
US 5008594	A	16-04-1991	NONE	
EP 0212931	A	04-03-1987	GB 2179503 A	04-03-1987

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 713-258 PCT	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US99/30521	International filing date (day/month/year) 22/12/1999	Priority date (day/month/year) 22/12/1998
International Patent Classification (IPC) or national classification and IPC H01T23/00		
Applicant ILLINOIS TOOL WORKS, INC. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  18/07/2000	Date of completion of this report  15.03.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Frisch, K  Telephone No. +49 89 2399 2559  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US99/30521

**I. Basis of the report**

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

**Description, pages:**

1-8 as originally filed

**Claims, No.:**

1-10 with telefax of 06/02/2001

**Drawings, sheets:**

1/2,2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

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☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims 6-10
	No: Claims 1-4
Inventive step (IS)	Yes: Claims 6-10
	No: Claims 1-4
Industrial applicability (IA)	Yes: Claims 1-10
	No: Claims

2. Citations and explanations  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**



Concerning Part V: Novelty, Inventive step, Industrial applicability:

Claim 1 defines an "ionizer monitor" per se, the monitor being "adapted to detect faults in an ionizer having high voltage circuits". These statements do not imply any feature of the monitor itself in clear terms, it being undefined what is being monitored and which faults are to be detected. The term "ionizer monitor" merely implies that the monitor should be suitable for use with an ionizer. In fact, the only feature of the monitor clearly stated in claim 1 is that it comprises a sensing circuit, which can be capacitively coupled to high voltage circuits (of an ionizer). Therefore, the vague and general wording of present claim 1 can be seen to cover any apparatus which uses capacitive coupling to sense a voltage in any electrical device and which is suitable for being coupled capacitively to the high voltage circuits of an ionizer as well.

It is however well known in the art of high voltage measurements to use a capacitively coupled voltage sensor, and such sensors are obviously also suitable for sensing the voltages in the high voltage circuits of an ionizer, such circuits not differing in principle from any other high-voltage circuits. The monitor defined in claim 1 is therefore deemed to lack novelty and inventive step over such well known prior art. The dependent claims 2 and 3 neither state nor imply any additional feature belonging to the monitor in clear terms, such that the subject-matter defined in these claims is also not new and inventive. Since it is obvious per se to provide any monitor with a display, the additional feature stated in claim 4 cannot add anything inventive to the subject-matter of claim 1.

It is noted that none of the documents mentioned in the international search report appears to disclose or suggest an ionizing apparatus which comprises an ionizer having high voltage reference and emitter circuits and a monitor having a sensing circuit capacitively coupled to these high voltage circuits of the ionizer. The combined ionizer/monitor device explained in the present description is therefore deemed to be novel and inventive over the available prior art. Similarly, none of the available documents suggest a method of detecting faults as defined in present claims 6-10, such that the subject-matter of these claims is deemed to be both new and inventive within the meaning of Articles 33.1-33.3 PCT.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/US99/30521

Concerning Part VIII: Clarity, Conciseness:

In claims 1 and 6 it is not clear which "high voltage circuits" are referred to, the structure and circuits of the ionizer being completely undefined. In these claims it is also obscure which "faults" are to be detected by the monitor, thereby making it uncertain which kind of monitor/method is sought defined in the claims.

In claims 2 and 8 it is obscure what is referred to as a "reference circuit" and an "emitter circuit", the structure and circuits of the ionizer being undefined. Furthermore, in claims 3 and 9 it is obscure what is referred to as a "self-balancing ionizer". In claim 9 it is finally obscure which "monitor" is referred to, no such device having been defined in claim 6, to which claim 9 refers. It is therefore not clear which additional features of the ionizer or of the claimed monitor and method are sought implied in claims 2, 3, 8 and 9.

What is claimed is:

1. An ionizer monitor adapted to detect faults in an ionizer having high voltage circuits, said monitor comprising a sensing circuit (13, 14) able to be capacitively coupled (18, 19) to said high voltage circuits for detecting faults.

2. An ionizer monitor as in claim 1, wherein said ionizer has a reference circuit (9) or an emitter circuit (8) and said sensing circuit (13, 14) is able to be capacitively coupled (18, 19) to a reference circuit (9) or an emitter circuit (8) of said ionizer.

3. An ionizer monitor as in claim 1, wherein said ionizer monitor is usable in connection with a self-balancing ionizer.

4. An ionizer monitor as in claim 1, further comprising an alarm display coupled to said sensing circuit for indicating fault detection.

5. An ionizer monitor as in claim 1, further comprising a control circuit coupled to said sensing circuit for controlling said ionizer responsive to fault detection.

6. A method of detecting faults in high voltage circuits of an ionizer without affecting operation of said high voltage circuits, said method comprising the step of:

sensing the voltage of said high voltage circuits by capacitively coupling a sensing circuit with said high voltage circuit; and

comparing the sensed voltage with a threshold voltage.

7. A method as in claim 6, further comprising the step of displaying an alarm if said sensed voltage is less than or equal to said threshold voltage.

8. A method as in claim 6, wherein said ionizer has a reference circuit (9) or an emitter circuit (8) and said sensing step includes capacitively coupling (13, 14) a sensing circuit (13, 14) with a reference circuit (9) or an emitter circuit (8).

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9. A method as in claim 6, wherein said ionizer monitor is usable in connection with a self-balancing ionizer.

10. A method as in claim 6, further comprising the step of controlling said ionizer in response to said sensing step sensing a voltage less than or equal to said threshold voltage.